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(71)Applicant : NIPPON STEEL CORP

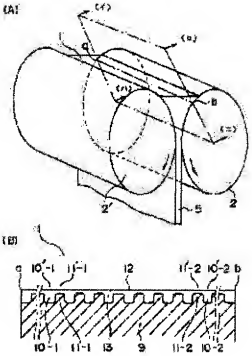
(72)Inventor : UEJIMA YOSHIYUKI
SHIO KIYOMI
MOROHOSHI TAKASHI
OGIBAYASHI SHIGEAKI

(54) CASTING DRUM OF TWIN DRUM TYPE CONTINUOUS CASTING MACHINE

(57)Abstract:

PURPOSE: To provide a thin slab having a smooth surface by using a drum which is provided with a copper inner layer with fine ruggedness on the outer surface and an outer layer which covers the inner layer and is made of the metal other than copper, and the surface of the outer layer is finished flat to prevent the cracking flaw.

CONSTITUTION: Casting drums 2, 2' are provided with an inner layer 9 made of copper having uniform and fine recessed parts 10 and projection parts 11 on the outer surface, and an outer layer 13 which covers the inner layer 9 and is made of the metal other than copper, and the outer surface 12 of the outer layer 13 is finished flat. For example, fine ruggedness of the inner layer 9 are formed by the shot blasting, and the Ni-plating or Cr-plating is applied on a surface of the inner layer 9, and the surface is polished to form the outer layer 13. For the projection parts 11 of the inner layer 9, the outer layer 13 is thin and its thermal conductivity is excellent, while for the recessed parts 10, the outer layer 13 is thick and its thermal conductivity is bad. When the molten metal 1 is brought into contact with the casting drums 1, 1', the part 11' fast in solidification and the part 10' slow in solidification are



uniformly mixed and distributed along the whole width of the thin slab 5. The generation of the cracking flaw in the thin slab 5 can be prevented.

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CLAIMS

[Claim(s)]
[Claim 1] It is the casting drum of the congruence drum type continuous casting machine which has the outer layer which consists of metals other than the copper which covered this inner layer on the external surface of the inner layer which consists of copper which has uniform and detailed irregularity, and this inner layer, and was formed outside on it at the surface, and is characterized by finishing the front face of this outer layer flat and smooth, and forming the front face of a casting drum.
[Claim 2] It is the casting drum of the congruence drum type continuous-casting machine which has the outer layer which consists of a metal which covered this etc. on the external surface of the inner layer which consists of copper which has uniform and detailed irregularity, the heat insulator arranged in this crevice of a inner layer, and a this inner layer and this heat insulator, and was formed outside on it at the surface, and is characterized by to finish the front face of this outer layer flat and smooth, and to form the outside surface of a casting drum.
[Claim 3] It is the casting drum of the congruence drum type continuous casting machine which it has the inner layer which turns into a surface from copper, and the outer layer which covered this inner layer on the external surface of this inner layer, and was formed in it, and this outer layer consists of a metal with which the heat insulator detailed inside was arranged by homogeneity, and the front face of this outer layer is finished flat and smooth, and is characterized by forming the front face of a casting drum.
[Claim 4] The casting drum of the congruence drum type continuous casting machine according to claim 2 characterized by the heat insulator arranged on this crevice of a inner layer being the hole made to form in this crevice of a inner layer.
[Claim 5] The casting drum of the congruence drum type continuous casting machine according to claim 3 whose metal with which the heat insulator was arranged on homogeneity is a metal with which the hole was allotted to homogeneity.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the casting drum of the congruence drum type continuous casting machine which manufactures a sheet metal cast piece.
[0002]
[Description of the Prior Art] Drawing 4 is the explanatory view of a congruence drum type continuous casting machine. Two level casting drums 2 and 2' are made to approach in parallel with the same height, and are arranged, and each is rotated in an arrow head 6 and the direction of 6'. 2 and 2' is stuck in the both ends of the shaft orientations of the casting drum 2 and 2', and the side weir 3 and 3' are arranged. In addition, the casting drum 2 and 2' are using copper as the base material by the internal water cooling type. A molten metal 1 is continuously poured into the up tooth space (cold slug well) formed by the drum 2, 2', and the side weir 3 and 3'. It is cooled by the casting drum 2 and 2', and the poured-in molten metal 1 forms the coagulation shell 4 and 4' in the front face of 2 and 2'. It is unified in the least interval section 7 of a drum, and this coagulation shell 4 and 4' become the sheet metal cast piece 5, and are taken out.
[0003] According to this congruence drum type continuous casting machine, in 3mm or less, although the board width can manufacture a sheet metal cast piece 1000mm or more, it is that ****, without performing a complicated back process, since this sheet metal cast piece is thin enough, or board thickness can use it as sheet metal by performing slight rolling at a back process. However, this sheet metal cast piece has during casting the trouble of being easy to generate a crack crack.
[0004] The casting drum which established many slots (width-of-face:0.05-0.20mm and depth:0.05-0.15mm) in the front face is indicated by JP,2-165849,A. If the casting drum which has much irregularity on a front face according to this invention person's etc. knowledge is used, the crack crack of a sheet metal cast piece will be reduced. However, the sheet metal cast piece manufactured using the casting drum which has much irregularity on the front face has the irregularity of a large number corresponding to the irregularity of a casting drum in the front face.
[0005] As already stated, the sheet metal cast piece by the congruence drum type continuous casting machine is the ****, or it is desirable to use it with slight rolling. However, since the front face is not smooth, an application is restricted, or in slight rolling, a concavo-convex trace remains in a front face, and the sheet metal cast piece which has much irregularity in a front face has the trouble of spoiling the fine sight as sheet metal.
[0006] The mold for continuous casting in which the refractories layer more than two-layer was formed to the mold operation side is indicated by Japanese Patent Application No. No. 67450 [six to]. In addition, TiN, TiC, AlN, and ZrN are indicated as an example of the 1st layer of the refractories layer more than two-layer, and ZrO2, aluminum 2O3, a spinel, and SiO2 are indicated as an example of the 2nd layer.
[0007] While generating the coagulation shell 4 in the contact initiation section 8 with a molten metal and resulting in the least interval section 7 in drawing 4 , it is made to grow up to be (t/2) of thickness.

Cooling on the casting drum 2 performs this growth. In order to rotate the casting drum 2 in a congruence drum type continuous casting machine at high speed, the growth time amount of the coagulation shell 4 from 8 to 7 is short. In order to grow up (t/2) of thickness into this short growth time amount, in a congruence drum type continuous casting machine, a casting drum with the large cooling power which used copper as the base material by the internal water cooling type is used.

[0008] If the refractories layer more than two-layer [of Japanese Patent Application No. 6-67450] is formed in this casting drum 2 that carries out high-speed rotation, since a refractories layer has heat transfer nature worse than copper, the cooling power of a casting drum declines and thickness cannot form (t/2) of coagulation shell. Therefore, although rotational speed of the casting drum 2 will be made late, if rotational speed of the casting drum 2 is made late, the volume of the sheet metal cast piece 5 per hour will decrease, and the trouble that the production efficiency of a continuous casting machine falls will occur.

[0009]

[Problem(s) to be Solved by the Invention] This invention is offering the technical problem the casting drum of the congruence drum type continuous casting machine which can prevent generating of a crack crack and can manufacture the sheet metal cast piece which does not have irregularity in a front face in high production efficiency.

[0010]

[Means for Solving the Problem and its Function] Drawing 1 is the ** type explanatory view of the surface of the casting drum of the 1st invention by this invention person etc., drawing 1 (A) is the explanatory view of the location of illustration, and drawing 1 (B) is the ** type explanatory view of the surface of the casting drum 2 of view (**), (**), (Ha), and a (d) cross section.

[0011] The inner layer 9 to which the 1st invention by this invention person etc. becomes a surface from the copper which has uniform and detailed a crevice 10 (10-1, --, 10-2) and heights 11 (11-1, --, 11-2) outside by drawing 1 , It is the casting drum of the congruence drum type continuous casting machine which has the outer layer 13 which consists of metals other than the copper which covered this inner layer 9 on the external surface of this inner layer 9, and was formed in it, and is characterized by finishing the outside surface 12 of this outer layer 13 flat and smooth, and forming the front face of the casting drum 2.

[0012] Although the configuration or magnitude of the detailed crevice 10 or heights 11 are not specified, if shot-blasting processing is performed, for example to the outside surface of a copper drum, height can form the inner layer 9 which has detailed irregularity by the abbreviation homogeneity which is 50 micrometers - 200 micrometers. Although the quality of the material or the formation approach of an outer layer 13 are not specified, either, nickel plating, Cr plating, and nickel+Cr plating can be performed to the front face of a inner layer 9, and an outer layer 13 can be easily formed by grinding a front face after plating construction. In addition, although the outside surface of an outer layer 13 is finished flat and smooth, as for smooth extent, it is desirable to consider as smooth extent of the usual cold rolling roll.

[0013] Due to drawing 1 (B), nickel or Cr which form the outer layer 13 cannot tell heat easily rather than Cu. Although the inner layer 9 is covered with the outer layer 13 which cannot tell heat easily, since the heights 11 (11-1, 11-2) of a inner layer 9 have the thin outer layer 13, its thermal conductivity is good, and since a crevice 10 (10-1, 10-2) has the thick outer layer 13, on the other hand, thermal conductivity is bad [the heights / a crevice]. For this reason, in the molten metal 1 in contact with a casting drum, it is quickly cooled on a casting drum and molten metal 11' (11' - 1 11' - 2) of the location which meets heights 11 (11-1, 11-2) has an early advance of coagulation. Molten metal 10' (10' - 1 10' - 2) of the location which, on the other hand, meets a crevice 10 (10-1, 10-2) has [that it is hard to be cooled] a slow advance of coagulation.

[0014] That is, if the casting drum of this invention is contacted, a molten metal 1 will turn into a molten metal in which detailed partial 11' (11' - 1 11' - 2) with an early advance of coagulation and detailed partial 10' (10' - 1 10' - 2) with a slow advance of coagulation carried out distribution mixing at homogeneity.

[0015] Each magnitude and distribution of this detailed part are controllable by selecting like a request the magnitude of the irregularity prepared in the external surface of a inner layer 9. Furthermore, it is 10' by selecting the class of metal of an outer layer 13, and the thickness of an outer layer 13. - 1 and 11' - Extent of a difference of advance of the coagulation of 1 is controllable like a request.
[0016] although the molten metal which the molten metal 1 in a cold slug well is poured in previously, and serves as low temperature by drawing 1 (A), and the newly poured-in hot molten metal are mixed -- this -- being mixed -- since it is inadequate, the elevated-temperature section and the low-temperature section are unevenly distributed in the molten metal 1 in a cold slug well in the shape of a layer.
[0017] When in the case of the casting drum which does not give the device according to rank a low-temperature molten metal layer is unevenly distributed near the a of drawing 1 (A) and a hot molten metal layer is unevenly distributed near the b, advance of coagulation since both 10'-1 near the a of drawing 1 (B) and 11'-1 are low temperature is 10'-2 early and near the b, and 11'. - Since both 2 is an elevated temperature, its advance of coagulation is slow. According to this invention person's etc. knowledge, if the field where advance of coagulation is early, and the field where advance of coagulation is slow are formed in this way, in a cast piece 5, it will be easy to generate a crack crack.
[0018] In this case, when the casting drum of this invention is used, 11'-1 is low temperature most, then distribution of the temperature of a molten metal is set to 11'-2, and then it is referred to as 10'-1, and then is 10'. - It can be referred to as 2. Coagulation will also advance according to this sequence. For this reason, coagulation advances to Mr. abbreviation 1 also near the b near the a, and it prevents that the field where advance of coagulation is early, and a late field are formed. Therefore, generating of the crack crack of a cast piece 5 is prevented.
[0019] Smoothing comparable as the usual cold rolling roll is made to the outside surface 12 of an outer layer 13 by this invention. Therefore, the front face of a sheet metal cast piece can also be made smooth to the same extent with the usual cold rolling material. For this reason, the trouble on the use which originated in the irregularity of a sheet metal cast piece, and had been generated conventionally is cancelable. Moreover, since metals used as the outer layer 13 of this invention, such as nickel and Cr, are metals, its thermal conductivity is notably higher than the refractories layer of Japanese Patent Application No. No. 67450 [six to]. For this reason, it is unnecessary to make rotational speed of the casting drum 2 late, and it can be operated in the same high efficiency as usual.
[0020] Drawing 2 is the ** type explanatory view of the surface of the casting drum of the 2nd invention by this invention person etc., and is drawing of the same part as drawing 1 (B). The inner layer 9 which the casting drum of drawing 2 becomes from the copper which has a crevice 10 and heights 11 uniform on external surface, and detailed on a surface, It has the outer layer 15 which consists of a metal which covered this etc. on the external surface of the heat insulator 14 arranged on the crevice 10 of the external surface of this inner layer, and a this inner layer 9 and a heat insulator 14, and was formed in it. The front face of this outer layer is the casting drum of the congruence drum type continuous casting machine characterized by being finished flat and smooth and forming the outside surface of the casting drum 2.
[0021] The inner layer 9 of drawing 2 can be formed by the same approach as the inner layer 9 of drawing 1 . Although a heat insulator 14 is used in the casting drum of drawing 2 , various kinds of refractories can be used as this heat insulator. In addition, although the crevice of a inner layer can also be made into a hole, the hole in this case does so the same operation effectiveness as a heat insulator. Copper is sufficient as the outer layer 15 of drawing 2 , and they may be metals, such as nickel other than copper, and Cr, again. This outer layer 15 can be easily formed with the means of common use, such as metallizing. The front face of an outer layer 15 is similarly finished flat and smooth with the outer layer 13 of drawing 1 having described.
[0022] Due to drawing 2 , a heat insulator cannot conduct heat easily notably rather than Cu. For this reason, although the heights 11 of the inner layer 9 without a heat insulator have good thermal conductivity, since there is a heat insulator, thermal conductivity is bad [a crevice 10]. for this reason -- casting -- a drum -- contacting -- **** -- a molten metal -- one -- setting -- heights -- 11 -- meeting -- a location -- a molten metal -- 11 -- ' -- rapid -- casting -- a drum -- cooling -- having -- coagulation --

advance -- being early -- although -- a crevice -- ten -- meeting -- a location -- a molten metal -- ten -- ' -- cooling -- having -- hard -- advance of coagulation -- being late .
[0023] namely, -- drawing 2 -- casting -- a drum -- contacting -- if -- a molten metal -- one -- coagulation -- advance -- being early -- detailed -- a part -- 11 -- ' -- coagulation -- advance -- being late -- detailed -- a part -- ten -- ' -- homogeneity -- distribution -- mixing -- having carried out -- a molten metal -- becoming . For this reason, the casting drum of drawing 2 also prevents generating of the crack crack of a cast piece 5 by the same reason with drawing 1 having described. Moreover, since the outside surface of an outer layer 15 is smooth, the trouble which originated in the irregularity of the front face of a sheet metal cast piece, and had been generated conventionally similarly is canceled with drawing 1 having described. Moreover, since the outer layer of drawing 2 is a metal, its thermal conductivity is notably higher than the refractories layer of Japanese Patent Application No. No. 67450 [six to], and since the copper of a inner layer 9 and the metal of an outer layer 15 are joined in the heights 11 of a inner layer, it has sufficient thermal conductivity. For this reason, it is unnecessary to make rotational speed of the casting drum 2 late, and it can be operated in the same high efficiency as usual.
[0024] Drawing 3 is the ** type explanatory view of other casting drums of this invention, and is drawing of the same part as drawing 1 (B). The casting drum of drawing 3 has the inner layer 17 which turns into a surface from copper, and the outer layer 16 which covered this inner layer 17 on the external surface of this inner layer 17, and was formed in it, and this outer layer 16 is the casting drum of the congruence drum type continuous-casting machine which consists of a metal with which the heat insulator 18 detailed inside was arranged by homogeneity, and the front face of this outer layer 16 is finished flat and smooth, and is characterized by forming the front face of a casting drum.
[0025] Copper is sufficient as the metal which constitutes the outer layer 16 from drawing 3 , and they may be metals, such as nickel other than copper, and Cr, again. Moreover, various kinds of refractories can be used as a heat insulator 18. The outer layer 16 where a heat insulator detailed inside drawing 3 consists of a metal arranged on homogeneity can arrange the cloth woven for the fiber of a heat insulator on the external surface of a inner layer 17, and can form it by carrying out thermal spraying of the metal, or plating it from on the. In addition, although the part of the heat insulator 18 of drawing 3 can also be made into a hole by selecting a spray condition without arranging the cloth woven for the fiber of a heat insulator, the hole in this case does so the same operation effectiveness as a heat insulator.
[0026] Due to drawing 3 , a heat insulator 18 cannot conduct heat easily notably rather than the metal which constitutes the outer layer. For this reason, although the part 19 without a heat insulator has good thermal conductivity, 20 with a heat insulator has bad thermal conductivity. for this reason -- casting -- a drum -- contacting -- **** -- a molten metal -- one -- setting -- 19 -- meeting -- a location -- a molten metal -- 19 -- ' -- casting -- a drum -- rapid -- cooling -- having -- coagulation -- advance -- being early -- although -- 20 -- meeting -- a location -- a molten metal -- 20 -- ' -- cooling -- having -- hard -- advance of coagulation -- being late .
[0027] That is, if the casting drum of drawing 3 is contacted, a molten metal 1 will turn into a molten metal in which detailed partial 19' with an early advance of coagulation and detailed partial 20' with a slow advance of coagulation carried out distribution mixing at homogeneity. For this reason, by the same reason, the casting drum of drawing 3 also prevents generating of the crack crack of a cast piece 5 with drawing 1 having described. Moreover, since the outside surface of an outer layer 16 is smooth, the trouble which originated in the irregularity of the front face of a sheet metal cast piece, and had been generated conventionally similarly is canceled with drawing 1 having described. Moreover, since it consists of a metal, the outer layer 16 of drawing 3 has thermal conductivity notably higher than the refractories of Japanese Patent Application No. No. 67450 [six to], is unnecessary for making rotational speed of a casting drum late, and can be operated in the same high efficiency as usual.
[0028]
[Example] Using four kinds of surface casting drums shown in Table 1, while board thickness was 2mm, the sheet metal cast piece of carbon aluminum killed steel was manufactured. In addition, a diameter is [400mm and the die length of each casting drum] 350mm, and each peripheral velocity of a casting drum is a part for 40m/.

[0029] It is an example of a comparison, and the drum A of Table 1 has neither a inner layer nor an outer layer, and is a copper independent surface. In addition, this casting drum A was finished flat and smooth so that surface roughness might be set to 10 micrometers or less. Although the drum B of Table 1 was an example of a comparison, and it has neither a inner layer nor an outer layer and was a copper independent surface, the front face of this casting drum B formed the irregularity of 80 micrometers in homogeneity with shot blasting. The drum C of Table 1 was an example of this invention, it formed the outer layer of nickel with a thickness of 30 micrometers in the external surface of the inner layer of the copper which formed the irregularity of 80 micrometers with shot blasting by plating, and it ground it so that surface roughness might be set to 10 micrometers or less after that.
[0030] It is O: (0-1cm) / m2, O: (1cm ** -10cm) / m2, **: (10cm ** -50cm) / m2, and x: (50cm **) / m2 in the result of having carried out acid washing of the cast piece which the column of a cast piece crack manufactured by Table 1, and having observed the surface crack crack with the 15 times as many magnifier as this. Moreover, it is O:0-8micrometer, O:8micrometer ** -15micrometer, **:15micrometer ** -30micrometer, and x:30-micrometer super-****** by the result of having measured the roughness of the cast piece of **** which the cast piece roughness column cast in Table 1 with the surface roughness plan.
[0031]
[Table 1]

ドラム	ドラム表面粗度	表　層	鋳片割れ	鋳片粗度	備考
A	10μm以下	銅単独の表層	×	○	比較例
B	80μm	銅単独の表層	○	×	比較例
C	10μm以下	粗度80μmの銅内層 ＋30μmのNi外層	○	○	本発明

[0032] A cast piece crack occurs only by making a drum front face smooth so that the drum A of Table 1 may sec. If irregularity is formed in a drum front face so that the drum B of Table 1 may see, a cast piece will serve as a split face. If the drum of this invention is used so that the drum C of Table 1 may see, a cast piece crack can be prevented and a front face can manufacture a smooth cast piece.
[0033]
[Effect of the Invention] If the casting drum of this invention is used, in congruence drum type continuous casting, generating of a crack crack can be prevented, and a sheet metal cast piece with a smooth front face can be manufactured, and production efficiency of a sheet metal cast piece will not be reduced.

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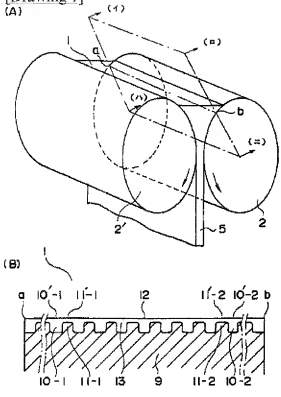
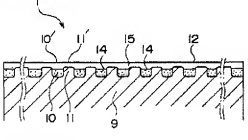
DRAWINGS

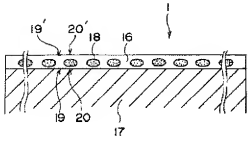
[Drawing 1]



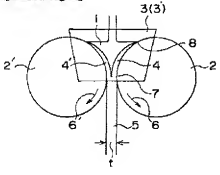
[Drawing 2]



[Drawing 3]



[Drawing 4]



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	11/04	３１２			11/04	３１２Ｆ

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(71)出願人　000006655
新日本製鐵株式会社
東京都千代田区大手町２丁目６番３号

(72)発明者　上島　良之
千葉県富津市新富20－１　新日本製鐵株式会社技術開発本部内

(72)発明者　塩　紀代美
千葉県富津市新富20－１　新日本製鐵株式会社技術開発本部内

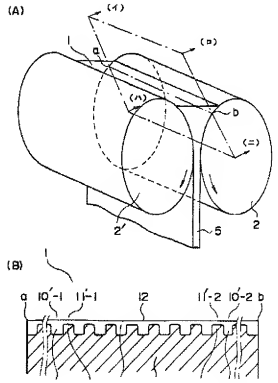
(72)発明者　諸星　隆
千葉県富津市新富20－１　新日本製鐵株式会社技術開発本部内

(74)代理人　弁理士　三浦　祐治

最終頁に続く

(54)【発明の名称】　双ドラム式連続鋳造機の鋳造ドラム

(57)【要約】
【目的】双ドラム式連続鋳造において、ワレ疵の発生を防止して表面が平滑な薄板鋳片を製造する事ができる鋳造ドラムを提供する。
【構成】鋳造ドラムの表層を内層と外層との２層の構造とし、銅の内層の外面に微細な凹凸を形成し、銅以外の金属の外層で覆い、外層の外面は平滑に仕上げる。あるいは銅の内層の該凹部に断熱材を配し、金属の外層で覆い外層の外面は平滑に仕上げる。あるいは銅の内層の外面に凹凸を形成しないで、内部に微細な断熱材が均一に配された金属よりなる外層でこの銅の内層を覆い、外層の外面は平滑に仕上げる。



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【特許請求の範囲】

【請求項1】表層に、外面に均一で微細な凹凸を有する銅よりなる内層と、該内層の外面に該内層を覆って形成された銅以外の金属よりなる外層とを有し、該外層の表面は平滑に仕上げられて鋳造ドラムの表面を形成していることを特徴とする、双ドラム式連続鋳造機の鋳造ドラム。

【請求項2】表層に、外面に均一で微細な凹凸を有する銅よりなる内層と、内層の該凹部に配した断熱材と、該内層と該断熱材の外面にこれ等を覆って形成された金属よりなる外層を有し、該外層の表面は平滑に仕上げられて鋳造ドラムの外表面を形成していることを特徴とする、双ドラム式連続鋳造機の鋳造ドラム。

【請求項3】表層に、銅よりなる内層と、該内層の外面に該内層を覆って形成された外層とを有し、該外層は内部に微細な断熱材が均一に配された金属よりなり、該外層の表面は平滑に仕上げられて、鋳造ドラムの表面を形成していることを特徴とする、双ドラム式連続鋳造機の鋳造ドラム。

【請求項4】内層の該凹部に配した断熱材が、内層の該凹部に形成せしめた空孔であることを特徴とする、請求項2に記載の双ドラム式連続鋳造機の鋳造ドラム。

【請求項5】断熱材が均一に配された金属が、空孔が均一に配された金属である、請求項3に記載の、双ドラム式連続鋳造機の鋳造ドラム。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、薄板鋳片を製造する双ドラム式連続鋳造機の鋳造ドラムに関する。

【０００２】

【従来の技術】図４は双ドラム式連続鋳造機の説明図である。２本の水平な鋳造ドラム２，２’を同じ高さに、平行に、かつ接近させて配設し、それぞれを矢印６，６’方向に回転させる。鋳造ドラム２，２’の軸方向の両端には２，２’に密着させて側堰３，３’を配設する。尚鋳造ドラム２，２’は内部水冷式で銅を基材としている。溶湯１をドラム２，２’と側堰３，３’とで形成された上部スペース（湯溜り）に連続的に注入する。注入された溶湯１は鋳造ドラム２，２’で冷却されて、２，２’の表面に凝固シェル４，４’を形成する。この凝固シェル４と４’はドラムの最小間隙部７で一体化され、薄板鋳片５となって取り出される。

【０００３】この双ドラム式連続鋳造機によると、板厚が３mm以下で板幅が１０００mm以上の薄板鋳片を製造することができるが、この薄板鋳片は十分に薄いため複雑な後工程を行うことなくそのまゝで、あるいは後工程で軽度の圧延を施す事により薄板として使用できる。しかしこの薄板鋳片は鋳造中にワレ疵が発生し易いという問題点がある。

【０００４】特開平２－１６５８４９号公報には、表面に幅：０．０５～０．２０mm、深さ：０．０５～０．１５mmの溝を多数設けた鋳造ドラムが記載されている。本発明者等の知見によると、表面に多数の凹凸を有する鋳造ドラムを用いると薄板鋳片のワレ疵は低減する。しかし表面に多数の凹凸を有する鋳造ドラムを用いて製造した薄板鋳片は、その表面に鋳造ドラムの凹凸に見合った多数の凹凸がある。

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【０００５】既に述べた如く、双ドラム式連続鋳造機による薄板鋳片は、そのまゝであるいは軽度の圧延により使用する事が望ましい。しかし表面に多数の凹凸がある薄板鋳片は、表面が平滑でないために用途が制限され、あるいは軽度の圧延では凹凸の痕跡が表面に残り薄板としての美観を損なうという問題点がある。

【０００６】特願平６－６７４５０号には鋳型稼動面に２層以上の耐火物層を形成した連続鋳造用鋳型が記載されている。尚２層以上の耐火物層の第１層の例としてはＴｉＮ，ＴｉＣ，ＡｌＮ，ＺｒＮがまた第２層の例としてはＺｒO_2，Ａｌ$_2O_3$，スピネル，ＳｉO_2が記載されている。

【０００７】図４で、凝固シェル４は、溶湯との接触開始部８で発生し、最小間隙部７に至る間に（ｔ／２）の厚さに成長させる。この成長は鋳造ドラム２による冷却によって行う。双ドラム式連続鋳造機では鋳造ドラム２を高速で回転させるために８から７に至る凝固シェル４の成長時間は短い。この短い成長時間内に（ｔ／２）の厚さに成長させるために、双ドラム式連続鋳造機では内部水冷式で銅を基材とした冷却力が大きい鋳造ドラムを用いる。

【０００８】この高速回転する鋳造ドラム２に特願平６－６７４５０の２層以上の耐火物層を形成すると、耐火物層は熱伝達性が銅よりも悪いために、鋳造ドラムの冷却力は低下して厚さが（ｔ／２）の凝固シェルを形成できない。従って鋳造ドラム２の回転速度を遅くする事となるが、鋳造ドラム２の回転速度を遅くすると、一時間当りの薄板鋳片５の生産量が少なくなり、連続鋳造機の生産能率が低下するという問題点が発生する。

【０００９】

【発明が解決しようとする課題】本発明は、表面に凹凸がない薄板鋳片をワレ疵の発生を防止して、かつ高い生産能率で製造する事ができる、双ドラム式連続鋳造機の鋳造ドラムの提供を課題としている。

【００１０】

【課題を解決するための手段および作用】図１は本発明者等による第１の発明の鋳造ドラムの表層の模式説明図で、図１（Ａ）は図示の位置の説明図、図１（Ｂ）は矢視（イ），（ロ），（ハ），（ニ）断面の鋳造ドラム２の表層の模式説明図である。

【００１１】本発明者等による第１の発明は、図１で表層に、外面に均一で微細な凹部１０（１０－１，…，１０－２）と凸部１１（１１－１，…，１１－２）とを有

する銅よりなる内層９と、該内層９の外面に該内層９を覆って形成された銅以外の金属よりなる外層１３とを有し、該外層１３の外表面１２は平滑に仕上げられて鋳造ドラム２の表面を形成していることを特徴とする、双ドラム式連続鋳造機の鋳造ドラムである。

【００１２】微細な凹部１０や凸部１１の形状や大きさは特定するものではないが、例えば銅のドラムの外表面にショットブラスト加工を施すと、高さが５０μｍ～２００μｍの略均一で微細な凹凸を有する内層９を形成する事ができる。外層１３の材質や形成方法も特定するものではないが、内層９の表面にＮｉメッキやＣｒメッキやＮｉ＋Ｃｒメッキを施し、メッキ施工の後に表面を研磨する事によって、外層１３を容易に形成することができる。尚外層１３の外表面は平滑に仕上げるが、平滑の程度は、例えば通常の冷間圧延ロールの平滑の程度とすることが望ましい。

【００１３】図１（Ｂ）で、外層１３を形成しているＮｉやＣｒは、Ｃｕよりも熱を伝え難い。内層９は熱を伝え難い外層１３により覆われているが、内層９の凸部１１（１１－１，１１－２）は外層１３が薄いために熱伝導性がよく、一方凹部１０（１０－１，１０－２）は外層１３が厚いために熱伝導性が悪い。このため鋳造ドラムと接触している溶湯１において、凸部１１（１１－１，１１－２）に対面する位置の溶湯１１’（１１’－１，１１’－２）は鋳造ドラムによって急速に冷却されて、凝固の進行が早い。一方凹部１０（１０－１，１０－２）に対面する位置の溶湯１０’（１０’－１，１０’－２）は冷却され難く凝固の進行が遅い。

【００１４】即ち本発明の鋳造ドラムに接触すると、溶湯１は、凝固の進行が早い微細部分１１’（１１’－１，１１’－２）と、凝固の進行が遅い微細部分１０’（１０’－１，１０’－２）とが均一に分布混合した溶湯となる。

【００１５】この微細部分のそれぞれの大きさや分布は、内層９の外面に設ける凹凸の大きさを所望の如くに選定することによって制御する事ができる。また更に、外層１３の金属の種類や外層１３の厚さを選定する事によって、１０’－１と１１’－１との凝固の進行の相違の程度を所望の如くに制御することができる。

【００１６】図１（Ａ）で、湯溜り内の溶湯１は、先に注入されて低温となっている溶湯と新たに注入された高温の溶湯とが混じり合っているが、この混じり合いは不十分であるため、湯溜り内の溶湯１には高温部と低温部が層状に偏在している。

【００１７】格別の工夫を施さない鋳造ドラムの場合、図１（Ａ）のａ近傍に例えば低温の溶湯層が偏在し、ｂ近傍に例えば高温の溶湯層が偏在すると、図１（Ｂ）のａ近傍の１０’－１，１１’－１は共に低温であるために凝固の進行が早く、ｂ近傍の１０’－２，１１’－２は共に高温であるために凝固の進行が遅い。本発明者等の知見によると、このように、凝固の進行が早い領域と凝固の進行が遅い領域とが形成されると鋳片５にはワレ疵が発生し易い。

【００１８】この際に本発明の鋳造ドラムを用いると、溶湯の温度の分布を、例えば１１’－１が最も低温で、次に１１’－２とし、次に１０’－１とし、次に１０’－２とする事ができる。凝固もこの順序に従って進行することとなる。このため凝固はａ近傍でもｂ近傍でも略一様に進行し、凝固の進行が早い領域と遅い領域とが形成される事を防止する。従って鋳片５のワレ疵の発生を防止する。

【００１９】本発明で外層１３の外表面１２は、例えば通常の冷間圧延ロールと同程度の平滑さに仕上げられている。従って薄板鋳片の表面も通常の冷間圧延材と同程度に平滑にする事ができる。このため薄板鋳片の凹凸に起因して従来発生していた使用上の問題点を解消することができる。また本発明の外層１３となるＮｉやＣｒ等の金属は、金属であるために特願平６－６７４５０号の耐火物層よりも熱伝導性が顕著に高い。このために鋳造ドラム２の回転速度を遅くする事は不必要で、従来と同様の高い能率で操業する事ができる。

【００２０】図２は本発明等による第２の発明の鋳造ドラムの表層の模式説明図で、図１（Ｂ）と同じ部分の図である。図２の鋳造ドラムは、表層に、外面に均一で微細な凹部１０と凸部１１とを有する銅よりなる内層９と、該内層の外面の凹部１０に配した断熱材１４と、該内層９と断熱材１４の外面にこれ等を覆って形成された金属よりなる外層１５とを有し、該外層の表面は平滑に仕上げられて鋳造ドラム２の外表面を形成していることを特徴とする、双ドラム式連続鋳造機の鋳造ドラムである。

【００２１】図２の内層９は図１の内層９と同じ方法で形成する事ができる。図２の鋳造ドラムにおいては断熱材１４を用いるが、この断熱材としては各種の耐火物を用いることができる。尚内層の凹部を空孔とする事もできるが、この際の空孔は、断熱材と同じ作用効果を奏する。図２の外層１５は銅でもよくまた銅以外のＮｉ，Ｃｒ等の金属であってもよい。この外層１５は、例えば金属溶射等の慣用の手段によって容易に形成する事ができる。外層１５の表面は、図１の外層１３で述べたと同様に平滑に仕上げる。

【００２２】図２で、断熱材はＣｕよりも熱を顕著に伝え難い。このため断熱材のない内層９の凸部１１は熱伝導性がよいが、凹部１０は断熱材があるために熱伝導性が悪い。このため、鋳造ドラムと接触している溶湯１において、凸部１１に対面する位置の溶湯１１’は急速に鋳造ドラムによって冷却されて凝固の進行は早いが、凹部１０に対面する位置の溶湯１０’は冷却され難く、凝固の進行が遅い。

【００２３】即ち図２の鋳造ドラムに接触すると、溶湯

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1は、凝固の進行が早い微細部分１１’と凝固の進行が遅い微細部分１０’とが均一に分布混合した溶湯となる。このため、図１で述べたと同様の理由で、図２の鋳造ドラムも鋳片５のワレ筋の発生を防止する。また外層１５の外表面は平滑であるために、図１で述べたと同様に、薄板鋳片の表面の凹凸に起因して従来発生していた問題点を解消する。また図２の外層は金属であるために、特願平６－６７４５０号の耐火物層よりも熱伝導性が顕著に高く、また内層の凸部１１において内層９の銅と外層１５の金属は接合されているために十分な熱伝導性を有する。このために鋳造ドラム２の回転速度を遅くする事は不必要で、従来と同様の高い能率で操業する事ができる。

【００２４】図３は、本発明の他の鋳造ドラムの模式説明図で、図１（Ｂ）と同じ部分の図である。図３の鋳造ドラムは、表層に、銅よりなる内層１７と、該内層１７の外面に該内層１７を覆って形成された外層１６とを有し、該外層１６は内部に微細な断熱材１８が均一に配された金属よりなり、該外層１６の表面は平滑に仕上げられて、鋳造ドラムの表面を形成していることを特徴とする、双ドラム式連続鋳造機の鋳造ドラムである。

【００２５】図３で、外層１６を構成している金属は銅でもよくまた銅以外のＮｉ，Ｃｒ等の金属であってもよい。また断熱材１８としては各種の耐火物を用いる事ができる。図３の内部に微細な断熱材が均一に配された金属よりなる外層１６は、例えば断熱材の繊維で織った布を内層１７の外面に配し、その上から金属を溶射しあるいはメッキする事によって形成する事ができる。尚断熱材の繊維で織った布を配しないで、溶射条件を選定する事により、図３の断熱材１８の部分を空孔とする事もできるが、この際の空孔は、断熱材と同じ作用効果を奏する。

【００２６】図３で、断熱材１８は外層を構成している金属よりも熱を遮蔽に伝え難い。このため断熱材がない部分１９は熱伝導性がよいが、断熱材がある２０は熱伝導性が悪い。このため、鋳造ドラムと接触している溶湯１において、１９に対面する位置の溶湯１９’は鋳造ドラムによって急速に冷却されて凝固の進行は早いが、２０に対面する位置の溶湯２０’は冷却され難く、凝固の進行が遅い。

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＊【００２７】即ち図３の鋳造ドラムに接触すると、溶湯１は、凝固の進行が早い微細部分１９’と、凝固の進行が遅い微細部分２０’とが均一に分布混合した溶湯となる。このため図１で述べたと同様の理由で、図３の鋳造ドラムも鋳片５のワレ筋の発生を防止する。また外層１６の外表面は平滑であるために、図１で述べたと同様に、薄板鋳片の表面の凹凸に起因して従来発生していた問題点を解消する。また図３の外層１６は金属よりなるために、特願平６－６７４５０号の耐火物よりも熱伝導性が顕著に高く、鋳造ドラムの回転速度を遅くする事は不必要で、従来と同様の高い能率で操業する事ができる。

【００２８】

【実施例】表１に示した表層の４種類の鋳造ドラムを用いて、板厚が２mmの中炭素Ａｌキルド鋼の薄板鋳片を製造した。尚鋳造ドラムは何れも，直径が４００mm、長さが３５０mmで、鋳造ドラムの周速度はいずれも４０m／分である。

【００２９】表１のドラムＡは比較例で、内層や外層を有しないもので、銅単独の表層である。尚この鋳造ドラムＡは表面の粗度が１０μmより上となるように平滑に仕上げた。表１のドラムＢは比較例で、内層や外層を有しないもので、銅単独の表層であるが、この鋳造ドラムＢの表面は、ショットブラストによって８０μmの凹凸を均一に形成した。表１のドラムＣは本発明例で、ショットブラストによって８０μmの凹凸を形成した銅の内層の外面に、メッキにより厚さ３０μmのＮｉの外層を形成し、その後、表面粗度が１０μm以下となるように研磨した。

【００３０】表１で、鋳片割れの欄は、製造した鋳片を酸洗し、１５倍のルーペで表面のワレ筋を観察した結果で、◎：（０～１cm）／m²，○：（１cm超～１０cm）／m²，△：（１０cm超～５０cm）／m²，×：（５０cm超）／m²である。また表１で鋳片粗度欄は、鋳造したまゝの鋳片の粗度を表面粗度計で測定した結果で、◎：０～８μm，○：８μm超～１５μm，△：１５μm超～３０μm，×：３０μm超である。

【００３１】

【表１】

＊

ドラム	ドラム表面粗度	表　層	鋳片割れ	鋳片粗度	備考
A	10μm以下	銅単独の表層	×	◎	比較例
B	80μm	銅単独の表層	◎	×	比較例
C	10μm以下	粗度80μmの銅内層＋30μmのNi外層	◎	◎	本発明

【００３２】表１のドラムＡにみられる如く、ドラム表面を平滑にしただけでは鋳片割れが発生する。表１のドラムＢにみられる如く、ドラム表面に凹凸を形成すると鋳片が粗面となる。表１のドラムＣにみられる如く、本発明のドラムを用いると、鋳片割れを防止しかつ表面が平滑な鋳片を製造する事ができる。

【００３３】【発明の効果】本発明の鋳造ドラムを用いると、双ドラ

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ム式連続鋳造において、ワレ疵の発生を防止して表面が平滑な薄板鋳片を製造することができ、かつ薄板鋳片の生産能率を低下させることがない。

【図面の簡単な説明】

【図１】は本発明の第１の鋳造ドラムの表層の模式説明図。

【図２】は本発明の第２の鋳造ドラムの表層の模式説明図。

【図３】は本発明の他の鋳造ドラムの表層の模式説明図。

【図４】は双ドラム式連続鋳造機の説明図。

【符号の説明】

１：溶湯、　２（２’）：鋳造ドラム、　３（３’）：

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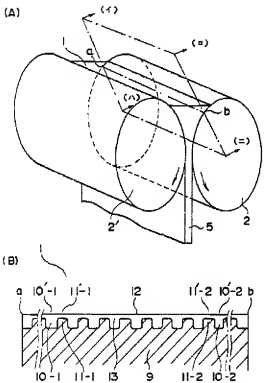
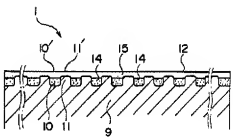
側堰、　４（４’）：凝固シェル、　５：薄板鋳片、６：鋳造ドラムの回転方向、　７：ドラムの最小間隙部、　８：溶湯との接触開始部、　９：銅の内層、　１０（１０－１，１０－２）：内層に設けた凹部、　１０’（１０’－１，１０’－２）：凝固の進行が遅い部分、　１１（１１－１，１１－２）：内層に設けた凸部、　１１’（１１’－１，１１’－２）：凝固の進行が早い部分、　１２：外層の外表面、　１３：外層、　１４：断熱材、　１５：外層、　１６：外層、　１７：銅の内層、　１８：断熱材、　１９：断熱材のない部分、　１９’：凝固の進行が早い部分、２０：断熱材のある部分、　２０：凝固の進行が遅い部分。

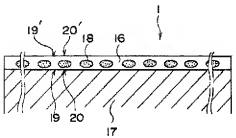
【図１】



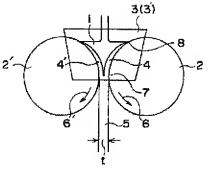
【図２】



【図３】



【図４】



フロントページの続き

(72)発明者　荻林　成章
千葉県富津市新富20－１　新日本製鐵株式
会社技術開発本部内